Journal of Bioeconomics 3: 171–193, 2001

Sex Differences in the Ultimatum Game: An Evolutionary Psychology Perspective

GAD SAAD
John Molson School of Business, Concordia University, Marketing Department, 1455 de Maisonneuve Blvd. W., Montreal, H3G 1M8, QC, Canada (gadsaad@jmsb.concordia.ca)

TRIPAT GILL
Weatherhead School of Management, Case Western Reserve University, Cleveland, Ohio, USA (tpg2@po.cwru.edu)

Synopsis: In the two-person ultimatum game, an allocator is required to split a given sum of money with a recipient. Subsequently the recipient can either accept or reject the offer. If it is accepted, both players receive their respective splits, while if it is rejected neither of them get anything. Using evolutionary psychology as the theoretical framework, we predicted and found that males made more generous offers when pitted against a female as opposed to a male. While females made equal offers independently of the sex of the recipient. That male allocators are altruistic towards female recipients and competitive with male recipients is construed as a manifestation of social rules, which evolve from the male pre-disposition to use resources for attracting mates. In contrast, females have not evolved such a pre-disposition, and thus, female allocators are more concerned about fairness when making offers to recipients. Several alternate explanations of the above findings are discussed and the evolutionary explanation is concluded as the most parsimonious one. Other potential moderators that are amenable to evolutionary explanations, namely, physical attractiveness, age and ethnicity of participants, are also discussed in this context.

Key words: economic games, human sex differences, social behavior.

JEL classification: C72, C91, J16

Introduction

The ultimatum game is an example of a non-cooperative bargaining situation, where player A (allocator) is asked to split a given sum of money with player B (recipient). The recipient can subsequently either accept or reject the offer. If the offer is accepted, both players receive their respective splits, but if it is rejected neither of them get anything. The ultimatum game has been characterized as an anomaly (Thaler 1988) because observed behavior is different from that expected from the rational economic principles of income maximization. The latter suggests that the offers made should be minimal (e.g., 1 cent or any other smallest possible denomination), and should accordingly be accepted, simply because from the perspective of the recipient, it is better than receiving nothing. However, several studies have shown that subjects have a tendency to be fair in the sense of dividing the money equally amongst each other, and also not making an offer that could be perceived to be unfair or too low to be accepted. In the study by

Güth et al. (1982) the mode and mean offers were 50% and 37% respectively of the total amount to be split. In a similar study by Kahneman et al. (1986) the mean minimum acceptable offer ranged from 20% to 26% of the total sum. They also found that 76% of subjects reported a tendency to be fair, rather than greedy in dividing money, and also that, recipients were willing to punish unfair allocators. Such behavior has been validated cross-culturally by Roth et al. (1991) using samples from Jerusalem, Ljubljana (Slovenia), Pittsburgh and Tokyo. Camerer & Thaler (1995) describe such a behavior as an example of a learnt manner, which is expected in social settings. Such an argument is further exemplified by the fact that in an ultimatum game study by Murnighan & Saxon (1998) it was found that minimal offers were accepted approximately 70% of the times amongst kindergarten children, as opposed to approximately 40% of the times amongst third- and sixth-graders. Thus, it appears that perceptions of fairness are learnt and are accordingly prone to socialization forces.

Given the numerous studies conducted, the robustness of the results in an ultimatum game is unquestionable. That being said, few studies have looked at possible moderators of such a behavior. One such study is that of Robert & Carnevale (1997) who found that groups as opposed to individuals adopt more of a rational perspective (i.e., self-maximizing), as opposed to a fair one, when making offers. Furthermore, the size of offers was moderated by whether they were made to in-group or out-group members. Clearly then, in a social situation such as in the ultimatum game, factors other than those related to economic gain might moderate one's behavior. One such moderator, proposed in the present study, is that of the sex of the two participants, namely the allocators and the recipients. The sex differences between the two participants could introduce or cue 'non-economic' motives, which may influence the outcomes in an ultimatum game. What might some of these motives be? To answer this question, we turn to evolutionary psychology as specifically applied to understanding the inter and intra-sexual interactions in humans. The latter interaction patterns are proposed to be influenced by, and have evolved from, the different reproductive strategies pursued by human males and females.

Evolutionary psychology of human sex differences

In his seminal work on parental investment and sexual selection, Trivers (1972) proposed that as a result of differential parental investment human males and females have evolved different reproductive strategies. Given that human females provide higher parental investment than their male counterparts they are more discriminating in choosing mates. In addition, given that human males also provide a significant level of parental investment, female choice is based on the willingness and ability of males to invest. Sexual selection operating through female choice has thus resulted in the evolution of distinct mating strategies in males and females. While males compete and court, females choose. Male competition and courting involves displaying traits that females value, and female choice involves correctly identifying the cues that signal the willingness and ability of males to invest. However, males being the

lesser investing of the sexes, can desert their mate after impregnation, and are thus more prone to short-term mating than females. On the other hand, females, on being deserted, can fool another male in investing in the young that is not their own. The latter conflict of interest has resulted in the evolution of adaptations that guard females and males against desertion and cuckolding, respectively (Trivers 1972).

The evolved adaptations take the form of preferences and pre-dispositions embodied in the distinct psychological mechanisms in males and females (Buss 1996). For example, in their work on sexual strategies theory, Buss & Schmitt (1993) identified distinct mate preferences among males and females. These sex-specific preferences have evolved to solve the distinct adaptive problems that males and females faced in a mating context. For example, they found that males have evolved a preference for youth and physical attractiveness among their mates, whereas females have evolved a preference for resource capabilities among theirs. Moreover, males tend to engage in short term mating strategies more often than females do, in order to maximize reproductive success. These results have been replicated by a myriad of behavioral scientists in a variety of contexts (cf. Greenless & McGrew 1994, Feingold 1992).

How might the above sex differences in reproductive strategies and mate preferences influence the social interactions between and within the two sexes? Evolutionary psychologists have identified several adaptations, i.e., evolved psychological mechanisms, which aid humans in social interactions and reasoning. For instance, the cheater-detection module that aids reasoning in social contracts and the face recognition module that helps remember the individuals that one interacted with (cf. Tooby & Cosmides 1992, Cosmides & Tooby 1992). Several other such modules underlie proximate social concerns that have a direct bearing on the ultimate objective of maximizing reproductive success (see Buss 1996 for a detailed discussion on this issue). One such concern is the selection of appropriate mates, and as discussed earlier, males and females have evolved distinct mating strategies and mate preferences. These distinct strategies embody innate pre-dispositions, which might result in evolved behavioral rules that influence social interactions between and within the two sexes. For instance, males, being keen on displaying the ability and willingness to invest resources in both short-term and long-term mates, might be pre-disposed to being altruistic towards females. Also, intra-sexual rivalry should be higher among males for resources, and among females for physical attractiveness, as these are the traits valued by their prospective mates. These pre-dispositions could result in the evolution of general behavioral rules such as 'males, be generous to females'. Several social norms can be considered a manifestation of this rule — for instance, 'men holding doors to women' or 'men vacating a seat for a woman'.

Sex differences in the ultimatum game

A few studies that have looked at sex interactions in an ultimatum game context have not done so through the lens of evolutionary psychology. Moreover, these studies have also not provided the requisite conditions to trigger the relevant evolutionary modules.

This is because they either used photographs instead of face-to-face interactions (cf. Solnick & Schweitzer 1999), or they involved a repeated game scenario where learning is likely to attenuate the effect of evolved pre-dispositions (cf. Eckel & Grossman 1992).[1] In the former case, the allocators' decisions become inconsequential (due to anonymity), while in the latter case, learning might have induced subjects to attend to the monetary, rather than social, consequences of their decisions. In contrast, a face-to-face design, such as ours, makes the allocators' decisions socially relevant, and thus creates sufficient grounds for the relevant evolutionary modules and the associated pre-dispositions to be triggered. Apart from the ultimatum game, there also exist a few studies that investigate sex effects in other game theoretic contexts. However, research that has addressed this important moderator has typically assumed that sex operates as a main effect rather than the posited interaction in the current work. For example, Kahn et al. (1971) found that females made fewer cooperative choices than males when playing the Prisoner's Dilemma game in same-sex pairs (study 1). Browne-Kruse & Hummels (1993), using same sex groups of four, found that males contributed to a public fund, at higher rates than females. Eckel & Grossman (1996) determined that in a two-stage dictator game, men were less likely to punish unfair behavior.

Typically, theories that espouse a main effect for sex are based on the central tenet that socialization forces create sex differences. In other words, in the 'nurture vs. nature' debate, the latter theories argue that it is the 'nurture' component that is operative. For example, in the study by Browne-Kruse & Hummels (1993), the authors proposed that since boys are more likely to play team games, this would translate into a greater sense of cooperation, thus explaining why males contributed more to a public fund. In contrast, Cadsby & Maynes (1998) argued that females are more sensitive to the concerns of the others around them, while males pursue a favored individual strategy. Accordingly, they showed that females contribute more than males in the initial stages of a repeated public goods game. The latter sex differences in cooperative behavior have also been shown by Ortmann & Tichy (1999) in the context of a repeated prisoner's dilemma, and by Mason et al. (1991) in a non-cooperative game situation. Though the results remain inconclusive, the literature predominantly suggests that females are more cooperative than males, and show a higher concern for fairness. The latter results are in accord with, and can be explained by, the central notion of social role theory— i.e., based on early socialization, males and females acquire agentic (assertive and instrumental) and communal (nurturance and yielding) traits, respectively (Eagly 1987). However, the origin of these distinct socialization patterns and their universality can only be explained through the evolutionary framework (cf. Archer 1996). Thus, applying the framework of evolutionary psychology, we propose that the phenomenon to be investigated here, namely differential offers in an ultimatum game across the four possible sex dyads, is a result of an interaction between 'nature-driven' pre-dispositions and the 'environmental' factors imposed by the social context. Specifically, the distinct mate preferences and mating strategies within males and females could have resulted in the evolution of general social rules—e.g., 'males—be generous to females', 'show off resources', 'be competitive with other males'. These rules are triggered in various social situations and affect individual behavior in these contexts. Evolutionary psychology is

used to explain why such rules exist and subsequently is used to posit hypotheses about individual level behavior that accord with these rules, as in a two-person ultimatum game.

Hypotheses

Since the ultimatum game is a resource-based game, with a monetary resource at stake, there should be a significant difference observed in the behaviors of male allocators as a function of the sex of the recipient. Specifically, when facing a female recipient the evolved pre-disposition to be altruistic towards females should be triggered in males. The latter pre-disposition increases the chances of males exploiting a potential mating opportunity by demonstrating a trait valued by females in both short-term and long-term mates (Buss & Schmitt 1993). This should increase the likelihood that males use the available resources (i.e., $10 in the ultimatum game) to make a good impression. The use of resources to access mates has been documented as a potential short-term mating strategy amongst men (Buss & Schmitt 1993). Also, a recent study by Saad & Gill (unpublished document) provides evidence that males are tactical in the use of resources and often have ulterior motives when offering gifts to romantic partners. In contrast, when facing a male recipient in an ultimatum bargaining situation, males should be pre-disposed to be competitive. This should especially be the case in the present context because a resource (i.e., monetary benefit) is at stake, and, in evolutionary terms, much of intra-sexual competition amongst males is to gain resources (Buss 1996). In summary, in an ultimatum game context, male allocators should make more generous offers to females than to males. Such differential behavior by males can be construed as an act of 'ulterior altruism' towards females and competitiveness towards males.

In the case of female allocators there does not exist any identifiable motive relating to a mating strategy, as the resource at stake is not what females compete on. As per the differential parental investment theory, it is males who are expected to provide resources to females and not vice versa (Trivers 1972). Females, being the ones that 'choose', would not have faced selection pressures to be altruistic towards males and competitive towards females in the context of resources. Findings in the evolutionary psychology literature are unequivocal that females do not use resources as a strategy for mate attraction, mate retention or for derogating intra-sexual competition (cf. Buss 1989, Schmitt & Buss 1993). If anything, females are likely to use sexual access and not resources to attract or retain mates (Buss 1989). Thus one would not expect any differences in the offers made by a female allocator to either a male or a female recipient. Moreover, given that females are more sensitive to the concerns of others (cf. Cadsby & Maynes 1998) they should be more concerned about being fair than being competitive or altruistic. Thus, they should not discriminate between female and male recipients in terms of the offers in an ultimatum game. Even though the latter prediction accords with the socialization-based social role theory (cf. Eagly 1987), their origins are evolutionary. However, sex-based socialization certainly plays an important role in maintaining social behavior that is consistent with the fitness interests of males and females

(Archer 1996, Buss 1996). It is not our contention that evolved pre-dispositions lead to behavior directly. Rather, they influence behavior, which ultimately is a result of human agency and intention.

Thus, we posit the following four hypotheses in the context of an ultimatum game:

H1: There will be a significant interaction effect between the sexes of the allocators and the recipients on the size of the offers made.
H2: Offers made in the male-female (MF) cell will be significantly greater than those made in the male-male (MM) cell.
H3: Offers made in the female-female (FF) and female-male (FM) cells will be equal.
H4: Amongst the four cells, offers in the MF cell will be the highest while those in the MM cell will be the lowest.

The above four hypotheses are based on the assumption that the evolutionary pre-dispositions relevant to mate selection can be generalized to situations such as an ultimatum game scenario. This generalization is appropriate because we contend that males should be pre-disposed to identifying mating opportunities whenever they present themselves. Even though not all males would exercise the option of exploiting this opportunity, the likelihood of it happening is the highest in the MF cell. Moreover, to posit that males would have evolved a mechanism that triggers the evolutionary mate selection module only in sexual encounters and not in situations like the ultimatum game would entail higher fitness[2] costs than gains. Thus, such a mechanism would not have evolved in human males.

The experiment

A 2 (sex of allocator) x 2 (sex of recipient) experiment, involving the simple ultimatum game with $10, was conducted. Thus, there were four cells namely, MM, MF, FM and FF. All of the instructions for playing the ultimatum game were provided in a written format and an explicit mention was made of the real monetary consequences of the game. Subjects were 238 undergraduate and graduate students enrolled at McGill University. Following the game, the subjects were given a claim sheet (receipts) for collecting their money from the experimenter at a later point in time.

The instruction sheet

The instruction sheet consisted of three pages containing information about the ultimatum game, a consent form, assignment as an allocator or recipient with specific instructions, and post-game questions relating to age, ethnicity, familiarity with the other player, and physical attractiveness of self and the other player. The first page of the instruction sheet had a detailed description of the ultimatum game describing the dynamics of the game in general terms using $10 and $X as symbols for representing the amount to be split and the amount offered respectively. Following this information was a consent form stating that participation was voluntary and did not involve any

physical or psychological risk to the participant. The subjects were required to sign the consent form prior to proceeding any further.

The second page of the instruction sheet assigned the subject as either an allocator or a recipient, and provided specific instructions regarding how to play the game. It was also stated that the experimenter was providing $10 for the game, thus the actions of the players carried real monetary consequences. Additionally, a game sheet was provided for recording the offer of the allocator. The same sheet was later passed on to the recipient for recording his/her decision to either accept or reject the offer.

The last page of the instruction sheet contained demographic questions relating to the age, sex and ethnicity of the subject. The latter questions were followed by a cover story describing another research study, which subjects were told was unrelated to the ultimatum game, dealing with the visual perceptions of physical attractiveness as rated by self and a third party (the experimenter). Subsequent to this cover story were questions on familiarity of the subject with the other participant (on a scale of 1 to 9; 'do not know at all' to 'know extremely well'), perception of one's self on physical attractiveness (on a scale of 1 to 9; 'extremely unattractive' to 'extremely attractive'), and perception of physical attractiveness of the other participant (on a scale of 1 to 9; 'extremely unattractive' to 'extremely attractive'). While the cover story claimed that the latter questions on familiarity and physical attractiveness were unrelated to the ultimatum game, in reality these were included to explore whether they might moderate the size of the offers made. In other words, given that the ultimatum game does not involve any communication between the two players, it was felt that familiarity and physical attractiveness, both of which can be evaluated without any communication between the two players, might be influential variables. (Refer to Appendix A for the instruction sheet, Appendix B for the game sheet and Appendix C for the claim sheet used in the ultimatum game experiment).

This instruction sheet was first pre-tested using five graduate students who were not native English speakers. The instructions about the game were fairly well understood except for some minor problems, which were subsequently corrected. Then followed another pretest with 8 graduate students (2 MF and 2 FM dyads) who were required to actually play the game. The instructions were clearly understood and the game was successfully completed void of problems or misunderstandings. Thus the instruction sheet and game sheet procedure was adopted for the main study.

Procedure

Experimental sessions were performed in nine different undergraduate or graduate classes over a period of three weeks. The instructors in these classes were requested to provide 25–30 minutes of class time either towards the beginning or the end of the class. The instructors were also requested to make an announcement about an interesting experiment involving real monetary consequences, while ensuring not to promise any specific amount of money with certainty. The classes were arranged in such a way that there was no overlap in terms of the same subjects being present in more than one class. The experiment was carried out by 3 to 5 different experimenters at any one time, who

had been trained and familiarized with all of the relevant procedures. At the onset of the experiment, an announcement was made about the real monetary consequences involved in the experiment, but no specific amount was mentioned. Then the subjects were randomly assigned an index card with a random number on it that was odd if the subject was male and even otherwise. Subsequently, a pair of numbers was called out from a pre-prepared sheet (called the experimenter's record sheet), which had series of pairs of numbers generated randomly. The pair was assigned to one of the experimenters and the two players holding the index cards with the two called out numbers were seated facing each other, with the experimenter in the middle. The instruction sheet specific to the allocator and the recipient were handed out to the subjects and they were instructed to begin. No negotiation was allowed amongst subjects, but they could ask the experimenter for any clarifications. Once the allocator had gone over page 2 of the instruction sheet, s/he was handed over the game sheet to record his/her offer. The same game sheet was then passed over to the recipient to record his/her decision (i.e., to reject or accept the offer).[3] Subsequently, the subjects filled out the post-game questions on the last page of the instruction sheet. At the same time the experimenter was also required to rate the two players on physical attractiveness (on a scale of 1 to 9; 'extremely unattractive' to 'extremely attractive'). Once these questions had been answered, the experimenter handed over a claim sheet containing the amount (depending on the outcome of the game) that they could pick up from the experimenter's office at specified times as stated on the sheet. The subjects were then asked to leave the classroom[4] as to not discuss the game with subjects that had yet to participate. The latter procedure was repeated until all the participants had been called. Upon completion of the experiment, subjects were debriefed and thanked for their participation. Of the 201 subjects who were eligible to receive money,[5] 92 (i.e., 46%) actually picked-up their money from the experimenter.

Results

A two-way ANOVA was performed on the data with the sexes of the allocator and the recipient serving as the factors. The results show a significant interaction effect[6] between the sexes of allocator and recipient on the amount offered, thus confirming the first hypothesis ($F_{1,115} = 4.13$; $p < 0.05$). In order to test H2 and H3, one-tailed contrasts were performed between the means of the respective cells (see Table 1). A significant difference between the mean offers in cells MF and MM was found. Specifically, offers in the MF cell were significantly higher than those in the MM cell (\$5.17 vs. \$4.25, $t_{115} = 2.70$; $p < 0.01$), thus confirming H2 while the offers in the cells FF and FM did not differ from each other (\$4.93 vs. \$5.00, $t_{115} = .203$; $p > 0.10$), which confirms H3[7]. To test H4, two one-tailed Bonferroni multiple contrasts were performed, namely MF with {FM, FF, MM} and MM with {MF, FM, FF}. While the results were not statistically significant, H4 was directionally supported.

Similar to other studies that have investigated the ultimatum game, the mode offer was 50%. The mean offer was \$4.82 with 86% of the offers made being accepted. The

Table 1. Mean Offers for the Four Dyads

CELL	N	OFFER ($)	Accept[a]	Reject[a]
FF	28	4.93	5.04 (25)	4.00 (3)
FM	30	5.00	5.11 (27)	4.00 (3)
MF	29	5.17	5.42 (24)	3.99 (5)
MM	32	4.25	4.54 (26)	3.00 (6)
Total	119	4.82	5.02 (102)	3.65 (17)

[a]Numbers in brackets denote the number of subject pairs who accepted or rejected the offer.

mean for accepted offers was $5.02 while that for rejected offers was $3.65. The aggregate data revealed that the offers were not distributed normally (Anderson-Darlington test for normality; $p < 0.001$) with offers ranging from $1 to $10 (see Figure 1).

Looking at the distribution of offers within each cell revealed several interesting patterns. As shown in Figure 2a, the most widespread distribution was found in the MF cell with 27% of the offers being greater than $5. This is quite an unusual finding as there is no economically rational reason for a person to be more than fair (at the expense of being unfair to oneself!), lending further support to the evolutionary account. Fifty-seven percent (8 out of 14) of all offers that were greater than $5 occurred in the MF cell. The MM cell contained the fewest number of offers greater than $5 (a single offer of $5.01) and the largest number of offers less than $4 (see Figure 2b). The findings in the FF and FM cells were very similar to each other with most of the offers concentrated at either $4 or $5 (see Figures 2c and 2d).[8]

In addition to looking at the offers made by allocators, we also looked at the rejection patterns in each of the cells. This analysis revealed that proposals from male allocators were more likely to be rejected than those from female allocators (18.03% vs. 10.34%).[9] But male and female recipients were equally likely to reject offers (14.52% vs. 14.03%). Moreover, both male and female recipients were more likely to reject offers from male rather than female allocators (18.75% vs. 10% and 17.24% vs. 10.71%, respectively). The rejection pattern of males, however, is confounded by the fact that they were offered less by male as compared to female allocators. On the other hand, the rejection pattern of females is surprising given that they were offered almost the same amount by both male and female allocators. The latter may be due to females' expectations being higher from male rather than female allocators. It should, however, be noted that due to small sample sizes within each cell of the rejection data, the above results are not significant and thus should be interpreted with caution.

Exploratory analyses

The variance of offers across the MF, MM, FF and FM cells were 1.87, 1.16, 0.81 and 1.26 respectively. Bartlett's test for the equality of variances revealed that the MF variance was significantly different from the others ($p = 0.00$) while the more

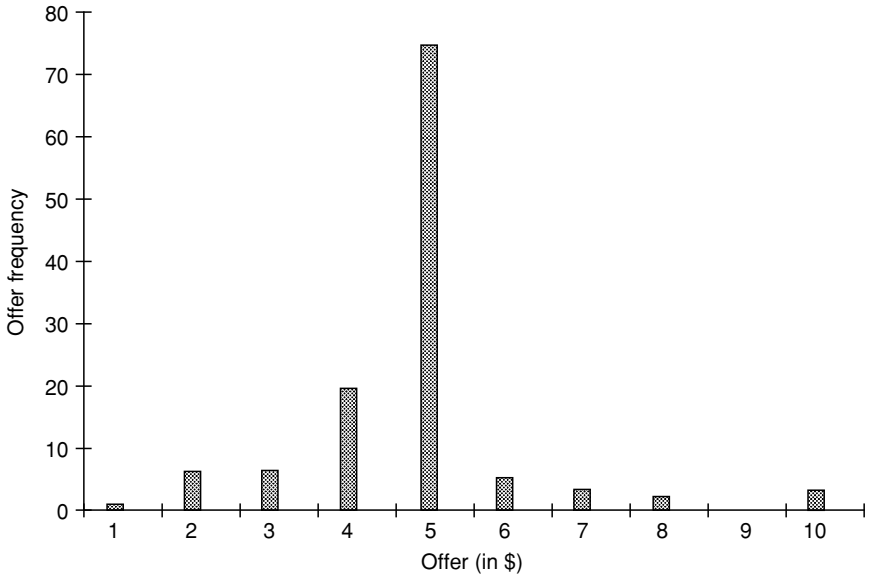

Figure 1. Distribution of Offers[a] for the Aggregate Data.

[a]Of the 119 offers made, 117 were integer values ranging from $1 to $10. In only two instances was a fractional offer made, namely one offer of $4.99 in the MF cell and another of $5.01 in the MM cell. These two offers are 'clumped' within the $5 category in all of the relevant figures for clarity of exposition.

conservative Levene's test yielded the same conclusion but at a lower significance level ($p = 0.101$). Might there be one or more specific moderators that could influence the size of an offer within a particular cell? For example, in the context of the MF cell, it was felt that given that males react strongly to physical attractiveness, this might explain the larger variance of offers within that cell. Similarly, several authors (cf. Larose et al. 1993) have found a jealousy effect between females as relating to physical attractiveness, hence potentially affecting behavior in the FF cell.

To address this issue we performed four separate best-subset regressions (one for each cell) with the size of an offer as the dependent variable and age, measures of familiarity[10] with the opposing player and measures of physical attractiveness serving as the independent variables. By and large, the results are disappointing. In retrospect, there are three reasons that might explain the null results: (1) subjects might have succumbed to the social desirability bias while providing the attractiveness ratings. In other words, they might have realized that the questions gauging physical attractiveness were related to the ultimatum game (contrary to what was stated in the cover story) and accordingly provided responses that were socially desirable. For example, a male allocator might not wish to divulge that his generous offer was due to the fact that the female recipient was exceedingly attractive and accordingly he might have reduced his rating of her attractiveness; (2) Given that the experiment was performed in a classroom setting wherein repeat interactions would occur, it is not surprising that

familiarity was not related to the size of an offer. In other words, even if the allocator does not know his/her opponent well enough, the fact that they shall interact in the future might induce the subject to provide an otherwise equally generous offer (as compared to if the participants knew one another quite well); (3) Each of the independent variables yielded responses with relatively minimal variance. For example, most participants' ratings (more than 70%) of physical attractiveness were in the 5 to 7 range, i.e., relatively few people rated either the other participant or themselves as very unattractive or as very attractive.[11]

Additional analyses were conducted on the data pertaining to the age and ethnicity of the participants. The data on the age difference between each of the allocator-recipient pairs was coded in two ways—as (1) 'actual age difference', based on the actual reported ages of the participants, and as (2) 'perceived age difference', based on an age difference of 5 years, a difference that could perhaps be gauged visually. Based on these two variables, each pair was classified as 'younger', 'same' or 'older' (from the collector's perspective), and an analysis was conducted to explore the effect of age difference on offer size—both overall and in each of the four cells. A chi-square analysis and an ANOVA revealed that age difference had no significant effect on offer size in any of the four cells. The only noteworthy finding here was that 7 of the 8 offers greater than \$5 in the MF cell were made to females in the same age group (i.e., those within +/– 5 years of

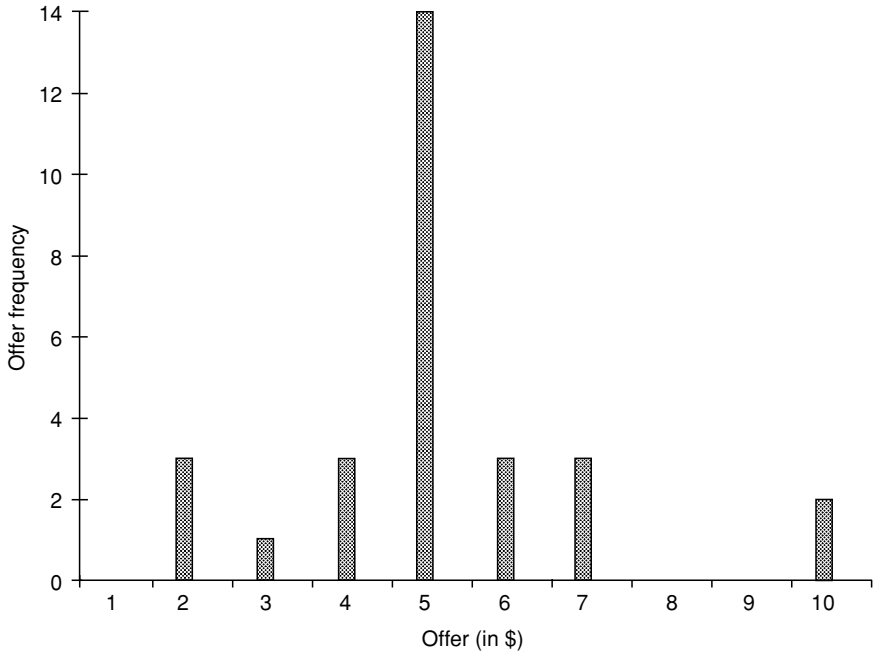

Figure 2a. Distribution of Offers in the Male-Female Cell. Recall that one of the offers shown under \$5 is actually \$4.99.

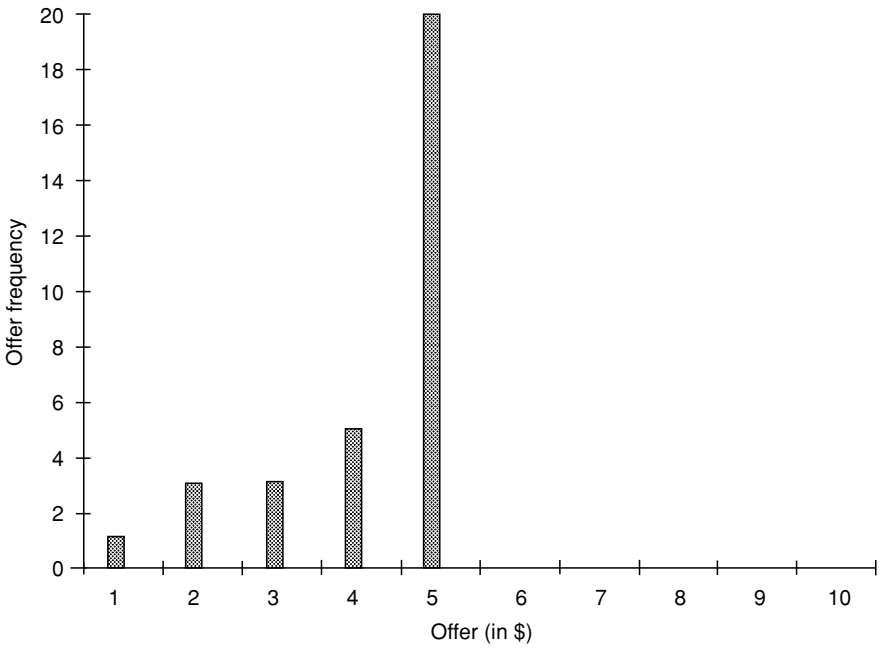

Figure 2b. Distribution of Offers in the Male-Male Cell. Recall that one of the offers shown under $5 is actually $5.01.

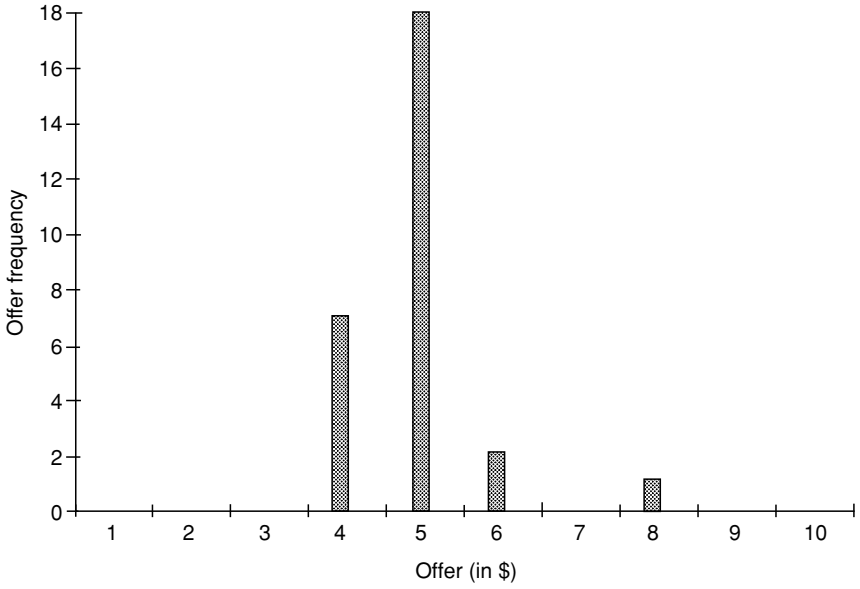

Figure 2c. Distribution of Offers in the Female-Female Cell.

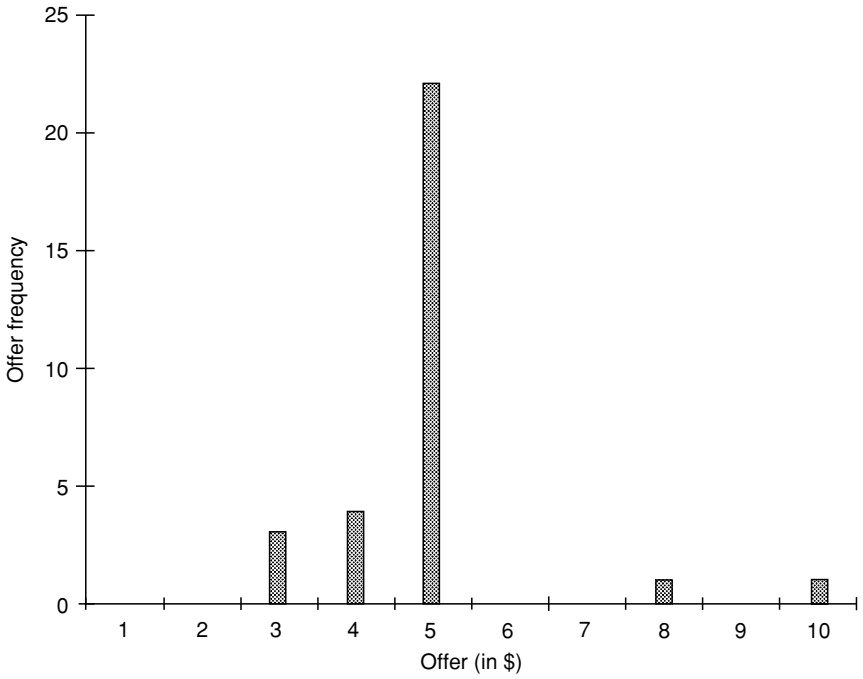

Figure 2d. Distribution of Offers in the Female-Male Cell.

age). Also, 11 of the 12 offers less than $5 in the MM cell were made to males in the same age group.[12] That males should use resources to attract mates, or to compete with rivals, within their own age group, is in accord with the evolutionary framework.

The ethnicity data revealed a total of 53 different ethnicities. We used this data to classify each dyad (i.e., each allocator-recipient pair) into two categories—either as 'same' (if the allocator and recipient were from the same ethnicity) or as 'different' (if they were from different ethnicities). The latter classification were performed using four different methods of splitting the ethnicity data—(1) an 'exact split' based on reported ethnicities, (2) a split based on ethnicity groups having a 'reasonable sample size' (i.e., greater than 10), (3) a split based on 'racial background' of participants (e.g., black, white, Asian, etc.), and (4) a further split based on ethnicities within each race that could be 'visually gauged' (e.g., Chinese and Japanese within the Asian race). Several statistical analyses were performed to explore the effect of ethnicity, using each of the above four splits of data, on offer size. The results from these analyses revealed that ethnicity had no significant effect on offer size—both overall and within each of the four cells. Furthermore, analyses exploring the interaction between age and ethnicity of the participants failed to produce any noteworthy or generalizable findings. These results could be due to small sample sizes in various ethnicity groups, or simply because sex, rather than ethnicity, is a more important moderator of offers made in an

ultimatum game. The latter claim, however, warrants further research, with larger sample sizes, and across different cultures.

Discussion

This study has shown that inter and intra-sex dynamics in a non-cooperative game, such as the ultimatum game, yield differential behavior that is consistent with an evolutionary psychological perspective. Such an account proposes that males and females have evolved distinct mating strategies and preferences for specific characteristics in the opposite sex. One such trait that is highly valued by females is the resource capabilities of males. As such, males have evolved the mechanism whereby as a means of attracting potential mates, they advertise their willingness to share their resources. The latter willingness could be in the form of altruistic behavior towards females or in the form of resource display. For example, the pattern of male-to-female gift-giving during courtship fully accords with this tenet. Inter-sex dynamics are replete with other examples that support this evolutionary pattern. In the current context, males were placed in either an intra or inter-sexual situation wherein monetary resources were at stake. As expected, MM and MF dyads yielded the lowest and most generous offers respectively while no differences were found between the FF and FM dyads since women do not typically compete on resources. That being said, are there any competing theories that could explain the pattern of results obtained here?

Theories of labor-market inequalities would predict that females might be the recipients of larger offers than males simply because historically they have been under-privileged in terms of equality of pay and opportunities. Thus, they would be shown greater generosity in economic bargaining situations such as in the ultimatum game. Hence, it would be reasonable to expect higher offers being made to a female recipient as compared to a male recipient. If it were indeed the case that females are being given higher offers solely as a result of perceived historical discrimination, then one would expect females punishing males in terms of the offers made. Thus one would expect the lowest offers in the FM cells and the highest in the FF cells. However, this pattern was not found in the current work. Moreover, studies in the area of perceived fairness of pay or promotion have reported no sex differences amongst these perceptions. Witt & Nye (1992) reported no sex differences in the level of perceived fairness of pay or promotions. Major & Forcey (1985) reported that when evaluating the fairness of pay, both men and women preferred to make same-sex comparisons (rather than combined-sex comparisons), and women thought they deserved less pay for their work than men. Hence, the labor-market inequalities cannot be considered a competing theory to explain the pattern of results obtained in this study.

Learning theories based on the differential socialization of males and females would predict that males are taught to be polite to females and competitive with other males. The latter socialization-based account could thus explain the results obtained in the current study. However, it is insufficient to merely state that males are polite or competitive because they have been taught to be so. Evolutionary psychol-

ogy explains why males are taught in such a manner, and why is this the case across cultures. Specifically, social norms such as politeness to women are adopted by cultures precisely because they are adaptive and hence yield higher reproductive success. Thus, evolutionary psychology does not compete with socialization-based theories, but rather complements them, by completing the causal sequence from learning to adaptive significance.

Several scholars have reported sex differences in risk-seeking behavior. Powell & Ansic (1997) showed that females are less risk seeking than males in the context of financial decision-making. Kohler (1996) confirmed earlier research on sensation seeking as a predictor of more risk-taking behavior by men as compared to women. These findings could point to a higher risk-taking propensity amongst males as compared to females in an ultimatum game. Such risk-taking should occur irrespective of whether the behavior is towards a male or female recipient. This prediction is however inconsistent with the results obtained in the current study. Moreover, the reason for offering more than 50% of the total amount might not solely fall within the risk-avoiding domain, instead altruism (possibly with ulterior motives) could explain such a behavior.

Social psychologists have explored the effect of a third person (e.g., an experimenter or observer) on subjects' responses in an experimental setting. For instance, Zajonc (1965) proposed that the presence of an audience acts as a socially induced drive that can facilitate or hinder the dominant response from subjects (termed as the 'audience effect'). However, the latter facilitation or hindrance occurs only if the subjects perceive the audience (e.g., an experimenter) as evaluative and able to influence outcomes (Cottrell 1968). Rosenthal (1966) proposed and found that several experimenter characteristics (e.g., sex, age, personality, etc.) can influence subjects' responses in an experiment (termed as the 'experimenter effect'). In the present context, the 'audience effect', if any, can be attributed to the mere presence of the experimenter, as the other subjects were blind to the outcomes of the experiment (i.e., the offers made by the allocators).[13] On the other hand, the 'experimenter effect' could be due to the sex of the experimenter, given that they were all males. To the extent that the 'audience effect' is operative here, it is likely to facilitate the dominant response exhibited by subjects, i.e., the number of 50% offers made. The latter effect has already been documented in dictator game studies that show that higher offers are made in the presence of an experimenter as compared to when the game is played in complete anonymity (cf. Hoffman et al. 1996). An 'audience effect', due to the mere presence of an experimenter, cannot account for the pattern of results obtained in the current study. Firstly, there is no reason to believe that the 'audience effect' should facilitate the dominant response (i.e., number of 50% offers) only for females and not for males. We found that the number of 50% offers were higher for female as compared to male allocators (69% vs. 52.5%, respectively). Secondly, even if it is assumed that the dominant response is hindered in males, why should it result in males being altruistic towards females (in the MF dyad), but competitive towards males (in the MM dyad)? If anything, the latter differential behavior should only get attenuated in the presence of an experimenter because it is not a socially desirable option. Could it be that the sex of the experimenter, given that they

were all males, differentially influenced the dominant response in male and female subjects? Several studies have shown that male experimenters behave more warmly with female as compared to male subjects, while female experimenters do not display such differential behavior (cf. Rosenthal 1966). The latter differential behavior by male experimenters could have facilitated the dominant response in female allocators. However, the 'experimenter effect', or lack thereof in the case of males, cannot account for the differential offers made by male allocators to male and female recipients. Our predictions based on evolutionary psychology provide a more parsimonious account of the offers made by both male and female allocators. Nevertheless, it would be worthwhile to explore the effect of the experimenter's sex on allocators' behavior in the ultimatum game. One would predict that if 'experimenter effects' are operative, the observed differential behavior of male allocators should be further accentuated in the presence of a female experimenter. In the evolutionary parlance, male allocators should care more about their reputation in the presence of a female rather than a male experimenter. Thus, they are more likely to signal their willingness to display and compete on resources in the presence of a female experimenter.

Future research

One fruitful area for future research would be to identify other two-person games wherein the evolutionary perspective might be further tested. One obvious choice is the dictator game, whereby the recipient does not have the power to reject the offer made to him/her. Any offer made by an allocator can be considered altruistic given that risk-aversion is removed from the game (since the recipient cannot reject the offer). Hence, one might find yet stronger results than those obtained in the current study, in the absence of any pressure to be fair. In one such study, involving a hypothetical dictator game scenario, Saad & Gill (2001) did find that males offered more to female than to male recipients. The latter study, however, needs to be verified in a more realistic setting where actual monetary benefits are at stake.

In the ultimatum game, no communication is allowed between the two players and no repeat interaction occurs. As such, the sole opportunity to 'communicate' with the opposing player is via the size of the offer made. However, there are other game contexts wherein sex dynamics might operate more directly via a greater interaction between the players. For example, Rapoport & Chammah (1965) investigated the behavior of same-sex and mixed pairs in 300 rounds of the Prisoner's Dilemma game. As such, players were 'communicating' via the repeat interactions. More recently, Cason & Mui (1997) studied the team dictator game whereby members of 'Team A' discuss amongst themselves the offer that would subsequently be made. Accordingly, a potential area for future research would be to test the evolutionary predictions across games requiring a differential level of interaction between the players. Should the results replicate across such varied contexts, it would further lend support to the robustness of the evolutionary framework.

The exploratory analyses revealed that physical attractiveness did not moderate the size of an offer. Several speculative arguments were proposed to explain this null effect, one of which was that subjects might have succumbed to the social desirability bias. To alleviate this potential problem, a study could be conducted whereby two confederates might play the role of recipient. One would be exceedingly attractive while the other would be exceedingly unattractive (both would be judged by independent raters and not by the actual subjects). The evolutionary perspective would propose that in the MF cell, the attractiveness of the recipient would be positively related to the size of the offer whereas in the FF cell, the relationship would be a negative one (jealousy effect). In the current study we found partial support for the latter. Additional analyses in the FF cell yielded that female allocators who offered less than \$5 rated themselves higher on physical attractiveness than those who offered \$5 or more (7.00 vs. 6.00, $t_{24} = 1.66$, $p = 0.05$). Moreover, female recipients who rejected the offers in the FF cell also rated themselves higher on physical attractiveness than those who accepted the offers (7.67 vs. 6.13, $t_{24} = 2.35$, $p < 0.05$). Both these results can be explained by the evolutionary account of female intra-sexual rivalry and competition on the dimension of physical attractiveness. The above findings are, however, based on very small sample sizes, and need to be verified in a future study. Kahn et al. (1971, study 2) investigated the effects of physical attractiveness in a prisoner's dilemma game. They stated that 'Since the present investigators were all males, no attempt was made to interpret feminine logic, and predictions concerning whether females would be more cooperative with attractive or ugly males were not made' (p. 272). Luckily for contemporary behavioral scientists, the evolutionary paradigm sheds light on both male and female logic irrespective of the researchers' genders!

We began the current research program to explore potential moderators that could be gauged visually (i.e., without verbal communication), and could affect behavior in dyadic interactions, such as the ultimatum game. The current study looks at the most prominent of these visual cues, i.e., the sex of the competing player, and to some extent the effect of physical attractiveness. Future research should explore the effect of other visual cues amenable to evolutionary predictions, such as the fertility, height, race, etc., of the two participants. In the current study we did record the ages of the participants, but, since most subjects were 'fertile' (80% of subjects were between 18 and 27 years), age was not relevant to any evolutionary-based predictions. Future studies that allow for a significant variation in participants' fertility, height and race could be employed to test evolutionary predictions based on these cues. These studies would help us understand how environmental cues that can be visually gauged such as fertility, height, race, etc interact with the evolutionary pre-dispositions to influence social behavior in specific contexts.

The current study highlights the usefulness of the evolutionary perspective in understanding human behavior in a traditional economic scenario, such as the ultimatum game. Through the ultimatum game economists have demonstrated the human instinct for fairness. The latter being a derivative of the evolved trait of reciprocal altruism—i.e., being fair in anticipation of reciprocity (Trivers 1972, Ridley 1996). The current study suggests that altruistic behavior among humans may be affected by

the preferences and pre-dispositions of the sexes involved. Males might be more altruistic towards females in light of a potential mating opportunity, and more competitive with other males in matters of sharing resources. In contrast, females should not display such differential behavior. It is our contention that these sex differences in behavior may not be an intentional, well thought out strategy, but rather an evolved, instinctive pre-disposition. However, being instinctive does not mean it is immutable. Environmental factors, such as the physical attractiveness, age, ethnicity, life stage etc., of the two interacting individuals, play an important role in determining the way these instincts translate into actual behavior.

Future research could also aim at testing scenarios where the evolutionary and the socialization-based learning theories make opposing predictions.[14] For instance, the classic works of Daly & Wilson (1985) on step-parents more likely to abuse/kill children, and that of Cosmides & Tooby (1992) on the evolution of a domain-specific cheater-detection mechanism, have demonstrated the superiority of the evolutionary framework over the traditional learning-based theories. In the context of mating, learning theories would predict that men should be especially polite to pregnant or elderly women, but these females should inspire no mating interest from an evolutionary perspective. Thus, males should offer less to pregnant or elderly females as compared to younger females, as per the evolutionary prediction. In contrast, learning-based theories would predict that the offers should at least be equal, if not more, to pregnant or elderly females. However, to the extent that males make any offer to elderly or pregnant females, it can be construed as a signal that enhances their reputation in the eyes of other females. Thus, even though males are taught to be polite to females who do not inspire any immediate mating interest, the latter behavior is adaptive in an evolutionary sense. Our study is not designed to test the efficacy of evolutionary versus learning-based predictions. Rather, it demonstrates the applicability of evolutionary psychology in predicting human behavior in a resource allocation context. In fact, to the extent that learnt behavior is an adaptive mechanism to enhance fitness interests, it might be futile to look for opposing predictions. In the words of Tooby & Cosmides (1992, p.123): 'We expect that the concept of learning will eventually disappear as cognitive psychologists and other researchers make progress in determining the actual causal sequences by which the functional business of the mind is transacted.'

Appendix A : ultimatum game instruction sheet

This study is being conducted under the auspices of Dr. Gad Saad (Concordia University) with Tripat Gill (a PhD student at McGill University). It investigates one's behavior in the ultimatum game. This game involves two players, call them Players A and B. Suppose that Player A is given $10 and is asked to divide this money between himself/herself and Player B. If Player A offers $X to Player B, then he/she is implicitly stating that he/she shall keep $(10-X). If Player B accepts the offer, each player keeps his/her respective split. If Player B rejects the offer, neither player gets anything. At no point are either player allowed to speak/negotiate with one another.

You have been randomly paired up with another subject to play the ultimatum game. It is important for you to know that there does not exist any one 'correct' split. At any point, should you have any questions, please do not hesitate to ask the experimenter.

As in all psychology experiments, you do not have to complete the experiment if you do not wish to. All responses that you give are strictly confidential. There are no physical or psychological risks associated with this study.

Consent-agreement

I have read the above statement and I am consenting to participate in the experiment of my own will. I understand that I am free to discontinue my participation at any time without suffering any disadvantage.

Name (print) Student ID # Signature Date

PART-A

Instructions for Player A

You have been randomly paired up with the subject facing you to play an ultimatum game with real monetary consequences. The experimenter shall provide $10 that shall be used for the game.

You have been randomly selected to be Player A (i.e., the person that makes the offer) while the subject facing you is Player B (i.e., the person that accepts or rejects the offer). Recall that if an offer is accepted, each of you receives your respective split whereas if the offer is rejected, neither of you receives anything.

Now you have to split this $10 with the subject facing you (i.e., Player B). What is your offer to Player B? Please indicate your offer in the provided game sheet.

Instructions for Player B

You have been randomly paired up with the subject facing you to play an ultimatum game with real monetary consequences. The experimenter shall provide $10 that shall be used for the game.

You have been randomly selected to be Player B (i.e., the person that accepts or rejects the offer) while the subject facing you is Player A (i.e., the person that makes the offer). Recall that if an offer is accepted, each of you receives your respective split whereas if the offer is rejected, neither of you receives anything.

The subject facing you (i.e. Player A) has been asked to split this $10 with you and has accordingly made an offer on the provided game sheet. On the same game sheet, please indicate whether you accept or reject the offer.

PART B

Please respond to the following general questions:

What was your index card number: _____

Sex: Male ____ Female _____

What is your ethnic background: _____

(e.g., Francophone, Anglophone, Greek-Canadian, Vietnamese-Canadian etc ...)?

The ensuing three questions are for another study that is also being conducted under the auspices of Dr. Gad Saad (Concordia University). They are in no way related to the Ultimatum game that you have just participated in. The study tries to determine whether one's visual perception of physical attractiveness is correlated with the perception of a third party (in this case, the experimenter is the third party).

1) How well do you know the subject that participated in this experiment with you:

Do not Know	.	.	.	.	.	.	.	.	.	Know
At All	1	2	3	4	5	6	7	8	9	Extremely Well

2) How do you rate yourself on physical attractiveness?

Extremely	.	.	.	.	.	.	.	.	.	Extremely
Unattractive	1	2	3	4	5	6	7	8	9	Attractive

3) How do you rate the subject facing you on physical attractiveness?

Extremely	.	.	.	.	.	.	.	.	.	Extremely
Unattractive	1	2	3	4	5	6	7	8	9	Attractive

Appendix B : game sheet for ultimatum game

GAME SHEET

Player A

I offer $ _____ to Player B.

Player B: (please circle one of the two underlined options)

I accept reject the offer of Player A.

Appendix C : claim sheet for ultimatum game

CLAIM SHEET

YOU CAN PICK UP YOUR $_____ AMOUNT AT **TRIPAT GILL'S** OFFICE (548 BRONFMAN: PHONE NO.: 398-4072) ON THE FOLLOWING DAYS:

1) WEDNESDAY APRIL 15th: 4.00 PM TO 5.00 PM

OR

2) THURSDAY APRIL 16th: 4.00 PM TO 6.00 PM

OR

3) FRIDAY APRIL 17th: 4.00 PM TO 6.00 PM

PLEASE BRING THIS SHEET AND YOUR STUDENT ID CARD FOR VERIFICATION PURPOSES.

Acknowledgements

We thank Peter Todd, XT Wang, and two anonymous reviewers for their insightful comments and suggestions that significantly benefited this paper.

Notes

1. See et al. (1992) as catalogued in EconLit abstracts.
2. Fitness here refers to the criterion of inclusive fitness (Hamilton 1964), which is used as a benchmark for predicting the evolution of an adaptive mechanism in an organism. Inclusive fitness is measured in terms of the chances of extending one's genes through reproduction and/or through one's genetically related kin.
3. Note that the offers made by the allocators as well as the decisions of the recipients, which were recorded (written) on the game sheet, were not visible to the other subjects present in the classroom. In other words, the ultimatum game decisions of each allocator-recipient pair were confidential and undisclosed to the other subjects.
4. The original number of subjects was 246. However, four dyads (3 FF and 1 FM) were dropped because they were run in a cafeteria (i.e., different setting) without the random pairing of the players. That being said, the inclusion of the latter four dyads does not change the results.
5. Only 201 of the total 238 subjects were eligible to receive money because there were 3 offers of \$10 (thus three allocators receive nothing) and there were 17 rejected offers (thus 34 subjects—17 allocators and 17 recipients, receive nothing).
6. The main effects for both the sex of allocator (M = 4.69 vs. F = 4.96) and the sex of recipient (M = 4.62 vs. F = 5.05) were not significant ($p > 0.05$). These findings are directionally consistent with those of Eckel & Grossman (1992) and Solnick & Schweitzer (1999), who both found that females offered more than males. However, as noted earlier, the latter findings are not directly comparable to ours as we employed a face-to-face one-shot ultimatum game scenario.
7. Given that the data was not normally distributed we also performed non-parametric tests to see if the four cells (MF, MM, FF and FM) corresponded to different populations. As per the Mann-Whitney rank sum test, the MF and MM cells did correspond to different populations ($p = 0.051$), while the FF and FM cells did not. The finding with respect to the MF and MM cells was, however, only marginally significant as per the Kolmogrov-Smirnov test ($p < 0.10$). These non-parametric tests lend further support to H2 and H3.
8. We also performed non-parametric tests on the percentage of offers made by males and females that were less than \$5, equal to \$5 and more than \$5. For instance, male allocators were more likely to offer less than \$5 to male rather than female recipients (37.5% vs. 27.6%). The results from these analyses were in support of our hypotheses and were similar to the ones obtained from mean offers. However, due to small sample

sizes for offers less than $5 and more than $5, the results didn't attain statistical significance, and are hence not reported.

9. This finding is in accord with that of Eckel & Grossman (1992).
10. The mean familiarity between subjects was 2.30 on a scale of 1 (do not know at all) to 9 (know extremely well).
11. Most of the experimenters' ratings (more than 75%) of physical attractiveness were between 4 and 8.
12. The 8th offer greater than $5 in the MF cell was made to a younger female and the 12th offer less than $5 in the MM cell was made to a younger male.
13. It could be argued that the mere presence of an audience may have affected the behavior of subjects participating in the game, even though they knew that the audience was unaware of the outcomes. However, the latter 'audience' effect cannot a-priori predict that males should behave more chivalrously towards females and competitively towards males, without resorting to similar evolutionary arguments that we posit here. That is, the latter behavioral norms of male chivalry or competition are evolved social rules that enhance the reproductive fitness of males. Nevertheless, future replications of our study, performed in the absence of an observing audience, would provide further credence to our findings.
14. We thank Peter Todd for this suggestion.

References cited

Archer, John. 1996. Sex differences in social behavior: are social role and evolutionary explanations compatible? American Psychologist 51(9):909–917.

Brown-Kruse, Jamie & David Hummels. 1993. Gender effects in laboratory public goods contribution: do individuals put their money where their mouth is? Journal of Economic Behavior and Organization 22:255–267.

Buss, David M. 1989. Sex differences in human mate preferences: evolutionary hypotheses tested in 37 cultures. Behavioral and Brain Sciences, 12:1–49.

Buss, David M. 1996. The evolutionary psychology of human social strategies. Pp. 3–38 in E. Tory Higgins & Arie W. Kruglanski (ed.) Social Psychology: Handbook of Basic Principles, The Guilford Press, New York.

Buss, David M. & David P. Schmitt. 1993. Sexual strategies theory: an evolutionary perspective on human mating. Psychological Review 100:204–232.

Cadsby, C. Bram & Elizabeth Maynes. 1998. Gender and free riding in a threshold public goods game: experimental evidence. Journal of Conflict Resolution 34(4):603–620.

Camerer, Colin & Richard H. Thaler. 1995. Anomalies: ultimatums, dictators and manners. Journal of Economic Perspectives 9:209–219.

Cason, Timothy N. & Vai-Lam Mui. 1997. A laboratory study of group polarization in the team dictator game. Economic Journal 107(444):1465–1483.

Cosmides, Leda & John Tooby. 1992. Cognitive adaptations for social exchange. Pp. 163–228 in J. H. Barkow, L. Cosmides & J. Tooby (ed.) The Adapted Mind: Evolutionary Psychology and the Generation of Culture, Oxford University Press, New York.

Cottrell, Nickolas B. 1968. Performance in the presence of other human beings. Mere presence, audience and affiliation effects. Pp. 91–110 in E. C. Simmel, R. A. Hoppe & G. A. Milton (ed.). Social Facilitation and Imitative Behavior. Allyn & Bacon, Boston.

Daly, Martin & Wilson, Margo. 1985. Child abuse and other risks of not living with both parents. Ethology & Sociobiology 6(4):197–210.

Eagly, Alice. 1987. Sex differences in social behavior: a social role theory interpretation. Hillsdale, NJ: Earlbaum.

Eckel, Catherine C. & Philip J. Grossman. 1992. Chivalry and solidarity in ultimatum games. Virginia Polytechnic Institute and State University Working Paper in Economics: E92–23. As catalogued in EconLit abstracts.

Eckel, Catherine C. & Philip J. Grossman. 1996. The relative price of fairness: gender differences in a punishment game. Journal of Economic Behavior and Organization 30:143–158.

Feingold, Alan. 1992. Gender differences in mate selection preferences: a test of the parental investment model. Psychological Bulletin 112:125–139.
Greenlees, Ian A. & William C. McGrew. 1994. Sex and age differences in preferences and tactics of mate attraction: analysis of published advertisements. Ethology and Sociobiology 15:59–72.
Güth, Werner, Rolf Schmittberger & Bernd Schwartze. 1982. An experimental analysis of ultimatum bargaining. Journal of Economic Behavior and Organization 3:367–388.
Hamilton, William D. 1964. The genetical evolution of social behavior. Journal of Theoretical Biology 7:1–52.
Hoffman, Elizabeth, Kevin McCabe & Vernon Smith. 1996. Social distance and other- regarding behavior in dictator games. American Economic Review 86(3):653–660.
Kahn, Arnold, Joe Hottes & William L. Davis. 1971. Cooperation and optimal responding in the prisoner's dilemma game: effects of sex and physical attractiveness. Journal of Personality and Social Psychology 17:267–279.
Kahneman, Daniel, Jack L. Knetsch & Richard H. Thaler. 1986. Fairness and the assumptions of economics. Journal of Business 59:285–300.
Kohler, Maxie P. 1996. Risk-taking behavior: a cognitive approach. Psychological Reports 78:489–490.
Larose, Helene, Joanne Tracy & Stuart J. McKelvie. 1993. Effect of gender on physical attractiveness stereotype. Journal of Psychology 127:677–680.
Major, Brenda & Blythe Forcey. 1985. Social comparisons and pay evaluations: preferences for same-sex and same-job wage comparisons. Journal of Experimental Social Psychology 21:393–405.
Mason, Charles F., Owen R. Phillips & Douglas B. Redington. 1991. The role of gender in a non-cooperative game. Journal of Economic Behavior and Organization 15:215–235.
Murnighan, J. Keith & Michael S. Saxon. 1998. Ultimatum bargaining by children and adults. Journal of Economic Psychology 19(4):415–445.
Ortmann, Andreas & Lisa K. Tichy. 1999. Gender differences in the laboratory: evidence from prisoner's dilemma games. Journal of Economic Behavior and Organization 39(3):327–339.
Powell, Melanie & David Ansic. 1997. Gender differences in risk behavior in financial decision-making: an experimental analysis. Journal of Economic Psychology 18:605–628.
Rapoport, Anatol & Albert M. Chammah. 1965. Sex differences in factors contributing to the level of cooperation in the prisoner's dilemma game. Journal of Personality and Social Psychology 2:831–838.
Ridley, Matt. 1996. The origins of virtue: human instincts and the evolution of cooperation. Penguin Books, London, UK.
Robert, Christopher & Peter J. Carnevale. 1997. Group choice in ultimatum bargaining. Organizational Behavior and Human Decision Processes 72:256–279.
Rosenthal, Robert. 1966. Experimenter effects in behavioral research. Appleton-Century-Crofts, New York.
Roth, Alvin E., Vesna Prasnikar, Shmuel Zamir & Masahiro Okuno-Fujiwara. 1991. Bargaining and market behavior in Jerusalem, Ljubljana, Pittsburgh, and Tokyo: an experimental study. American Economic Review 81:1068–1095.
Saad, Gad & Tripat Gill. 2001. The effects of a recipient's gender in a modified dictator game. Applied Economics Letters. 8(7):463–466.
Schmitt, David P. & David M. Buss. 1996. Strategic self-promotion and competitor derogation: sex and context effects on the perceived effectiveness of mate attraction tactics. Journal of Personality and Social Psychology 70(6):1185–1204.
Solnick, Sara J. & Maurice E. Schweitzer. 1999. The influence of physical attractiveness and gender on ultimatum game decisions. Organizational Behavior and Human Decision Processes 79(3):199–215.
Thaler, Richard H. 1988. Anomalies: the ultimatum game. Journal of Economic Perspectives 2:195–206.
Tooby, John & Leda Cosmides. 1992. Psychological foundations of culture. Pp. 19–136 in J. H. Barkow, L. Cosmides & J. Tooby (ed.) The Adapted Mind: Evolutionary Psychology and the Generation of Culture, Oxford University Press, New York.
Trivers, Robert L. 1972. Parental investment and sexual selection. Pp. 136–179 in B. Campbell (ed.) Sexual Selection and the Descent of Man, 1871–1971, Chicago, Aldine.
Witt, L. Alan & Lendell G. Nye. 1992. Gender and the relationship between perceived fairness of pay or promotion and job satisfaction. Journal of Applied Psychology 77:910–917.
Zajonc, Robert B. 1965. Social facilitation. Science 149:269–274.